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Early Spring Plants of Central North Dakota.

J. LUNELL.

It would be rather deceptive to determine the arrival of spring in North Dakota by the almanac. Sometimes it commences in March, but as a rule not until April. It does not set in promptly, as in the far north, where the Snowdrop, *Galanthus nivalis* springs up well-nigh from the bosom of a snow drift, and the *Narcissus, Crocus, Tulipa* and *Hyacinthus* follow just as soon as the ground is bare. On the contrary, Nature awakens very slowly here, and its progress is lingering, and it is timid and careful, afraid of being taken by surprise, the weather becomes slowly and imperceptibly warmer, and the first spring flower, *Pulsatilla hirsutissima,* dares at last to burst forth, after two weeks of hesitation. Invariably it receives its punishment, as the frost reaps millions of these flowers every spring. But another succession of flowers appears, the plumose styles and the leaves grow out, and late flowers are borne contemporaneously with the fully developed leaves in June and even July. The common name of this plant here is *Crocus,* probably because its sepals have the same size and shape of this offspring of the celebrated family *Iriuaceae,* because both are children of the earliest spring, and because this, as we have no real *Crocus,* is the best "Crocus" available. Not even *Sanguinaria canadensis,* a plant growing in the extreme eastern part of the state, reaches this territory. The first day I found the *Pulsatilla* this year was on the 24th of March.

After this day comes a period of slow and tedious expectation, until by April 10th *Ranunculus ovalis* enters the stage, now just as tiny and tender as it is rank and exuberant four weeks later. *Acer fraxinifolium, Populus balsamifera candicans, deltoides* and *tremuloides, Ulmus fulva* and *americana* and *Celtis crassifolia* bring forth their flowers in advance of the leaves by this time, followed two weeks later by *Prunus*

* June 15, 1910.—Pages 197 to 228.

americana, and still two or three weeks later by the aments of *Salix Bebbiana, candida, cordata, discolor* and *petiolaris*, the leaves of all of these appearing later than the flowers.

The herb coming next to *Ranunculus ovalis* is *Viola Lunellii* Greene, peeping out on April 18th, and two or three days later *Potentilla concinna* and *Lomatium orientale* never fail to present themselves, the latter being synchronous with *Cymopterus acaulis* and *Lomatium villosum* in the western part of the state. Now enter in quick succession *Viola Nuttallii* on the hill tops and *V. vallicola* further down the hill sides, and *V. Rydbergii* is the first blossom of the year penetrating the deep shade beneath the trees of the woods. Somewhat later than these *Viola anisopetala* Greene, and *V. pedatifida* are due. At this time *Mertensia foliosa* and further west *M. coronata* (or species very much resembling these natives of western Wyoming) enhance the beauty of the prairie.

An excursion on the 23d of April resulted in the following finds: *Phlox Hoodii, Lesquerella Lunellii* (maybe the most lovely looking plant of the genus, and at this time west of the divide replaced with *L. montana*), *Orophaca caespitosa* and *Carex filifolia*, all of these plants preferring the summits or the slopes of the hills, while *Antennaria campestris* loves the damp meadows, *Plantago eriopoda* chooses the whitish, alkaline low-land, and the holy grass, *Savastana odorata*, as the first-born of its family, gives a faint idea how magnificent the prairie will look when it becomes green at last.

Another excursion was made to Butte, on the 30th of April, which added the following plants to the spring flora: *Amelanchier alnifolia* in blossom and the just opened young leaves, *Sieversia ciliata, Comandra pallida, Androsace puberulenta* (in some other localities east and west of here replaced by *A. occidentalis*), *Nothocalais cuspidata, Thalictrum thyrsoideum* Greene, *Astragalus crassicarpus, Fragaria glauca* and *Aragallus dispar*. The last named plant is local for Butte, and transforms this place on the high hills into a veritable paradise during those ten days when it is blossoming. I have counted on its flowers a variation of sixteen different shades of gorgeous colors, from white, cream color, ochroleucous, light and dark blue, to light and dark rose purple, surpassing in their diversity all other plants of this state and probably of many other countries.

Of introduced plants these pariahs of the vegetable kingdom always unwelcome, undesirable hangers-on, nuisances in the path of civilization, weeds in the fields and around the railway stations, along the streets and in the yards of our cities, where they supplant the native herbs, as weeds often becoming

a still higher grade of nuisances than they are in their native countries, of so many different kinds later in the season, we have only one representative in the early spring, the common Dandelion, *Taraxacum officinale.* This plant seems to have decided to conquer the earth, not even respecting the virgin prairie, where it often is smothering most other forms of plant life. Only a few years have passed since its first invasion, but we all understand that it came here to stay permanently.

This being an unusually early spring, with its vegetation three or four weeks in advance of what is produced in an average spring season, a continued chronological enumeration of plants would drift us into the flora of late spring or early summer. As this is quite a complete record of our early spring flora, it proves certainly beyond doubt that this flora is rather deficient in species numerically, and the flowering time for this flora is very variable for different years. However, such disturbances disappear gradually as the season advances, and the equilibrium is restored altogether at or maybe before the end of June. A plant like *Lilium umbellatum,* due on July 1st, knows and obeys this law, and will always arrive on time just when it is due.

Leeds, North Dakota.

Notes on the Seedlings of Bloodroot.

J. A. NIEUWLAND.

Having been fortunate during the season just past in securing typical stages of development of seedlings, I proceeded to examine these systematically with a view of obtaining results worthy of record. A more thorough anatomical investigation must, however, be reserved for future study.

The plants were specimens of the common Bloodroot of our middle western prairie region, which seem to be *Sanguinaria mesochora,* Greene,* or *Sanguinaria canadensis,* Linn., and of the authors in part. This species proposed by Dr. E. L. Greene appears to be somewhat different from the plants of the middle Atlantic States, and of New England and Northern Canada. The flowers of the mature plants, around which the seedlings were found, are comparatively small and almost invariably quadrate, of four large, broad outer petals and four smaller, shorter, and narrower inner ones. The flower has a

* Greene, E. L. Pittonia, Vol. V, p. 306-308.

distinct squarish appearance when full blown. Only once have six petalled flowers been found out of hundreds examined in the last six years, and once too was a four petalled specimen obtained, the petals of the latter being the outer larger ones. Nine petals were once found, the ninth so placed as hardly to interfere with the quadrate appearance of the corolla. These three cases being so rare, I have considered them as teratological.

The foliage of the plants is quite large in fruit, the single leaf in anthesis being about the length of the scape whose flower is enclosed by it. The petiole lengthens out in fruit, and should the latter fail to develop, or be removed the leaf-blade shows a special tendency to increase in size. It is on mature plants almost always seven lobed, round, not broader than long, the apical lobe smallest and the basal ones largest. the whole leaf often six inches in diameter. The relations of the various species of Bloodroot proposed by the above-mentioned author can best be understood from the original publication.*

The Bloodroots are distinctly and exclusively American, and though known before the time of Dillenius,† he seems to be the first botanist of note that recognized the plants as of distinct generic standing. He called the several kinds that he recognized by the name *Sanguinaria*. This name had, however, been used by Pliny and the older herbalists of the seventeenth century for a grass, and so on the basis of strict absolute priority, the name would, after all, be a homonym for Bloodroot. For this reason in 1763, and before 1753 as a "starting point" for botanical nomenclature was dreamed of, Adanson, gave the genus the name *Belharnosia*. The name, strictly speaking valid for the plant, was not taken up, and many do not know that it was given, or why. Bubani‡ in his Flora Pyrenaea restores the Plinian name *Sanguinaria* to our so-called *Digitaria*, and accepts Adanson's name for the Bloodroot.

Linnaeus in his Species Plantarum accepted the Dillenian name, but reduced his several species to one under the Trivial name *Sanguinaria canadensis*, content to designate the others as varieties. This opinion was held up to a few years ago, and the genus was considered as monotypic.

Dillenius** seems to quote Morin as responsible for the

* loc. cit.

† Dillenius, J. Hortus Elthamensis, Vol. 2, p. 21.

‡ Bubani, P., Flora Pyrenaea, (1901). Vol. 4. p. 256.

** The Bloodroots illustrated by Dillenius were of course eastern American specimens and all show the leaves shorter than the flowers in full bloom.

name *Sanguinaria*. The plant was first recorded in the pioneer work on American botany, *Historia Plantarum Canadensium*, of J. P. Cornut, in 1635. He called the plant *Chelidonium americanum flore albo*. John Parkinson†† refers to the plant as *Ranunculus Virginiensis albus*. Robert Morison§§ accepts essentially Cornut's name, *Chelidonium maximum canadense acaulon*. Plunkenet§ recognizing its affinity to the Poppies, called it *Papaver corniculatum, seu Chelidonium humile cauliculo nudo, flore albo stellato*. Dillenius says that the natives called the plant *Pocan*, a name also applied to *Phytolacca* or Pokeweed, in the American colonies.

The seeds of Bloodroot appear to germinate in the fall as well as early spring, especially when warm rains occur late in the season. Several or a dozen plants may usually be found near the older plants while these latter are still in bloom. The seeds ripen in summer early. The seedlings vary somewhat in appearance, size, and development depending upon the condition in which thy germinate, especially nutriment, soil, shade. Injury to the first leaves greatly retards the plants, and two year old plants may be found that are smaller than the plants of the season. The plants, however, immediately begin to replace injured or aborted leaves, and though they seldom have more than one leaf at a time at the end of the rhizome, seedlings with two have been found. Old retarded plants can be easily recognized from seedlings by the presence of several scales at the apex of the rhizome. Replacing of injured or aborted leaves may take place any time if the season is not too far advanced.

Plants germinating in drier sunny places have shorter petioles to their leaves than those growing in shady places covered with the dry leaf mould of last fall. This difference is evident from a comparison of Plates 1 and 2, the former growing in more sun-exposed places and clayey soil. The plants in each are arranged from left to right in order of age. In the second row of Plate 1 is a two leaved specimen and next to it a seedling that had three cotyledons.

The cotyledons of Bloodroot are obovate, about 5 to 8 mm. long and about 3-4 mm. wide, tapering to a short channelled petiole. They are flesh-colored to light orange, chlorophylless and hypogeal. The color is due to the presence of several laticiferous ducts around each of the five to seven primitive wood bundles which branch out palmately from the petiole, and come together again at the rounded or obtuse apex.

†† Parkinson, J., Theatrum Botanicum, (1640). p. 327.
§§ Morison, R. Historia Plantarum, (1680). Part I, p. 257.
§ Plukenet, L. Almagestum Botanicum, (1696). p. 280.

The seeds are exalbuminous containing a large raphe along one side; they are black and smooth. After germination the empty seedcoat is found indifferently on the ends of the cotyledons, or on the apex of the first leaf. Often it falls off in the process of germination. When three cotyledons are present, their shape does not vary, but they are smaller than the usual two. The cotyledons wither in a few weeks.

The first leaf is palmately veined, orbicular in outline, cordate at the base devoid of any lobes, but with just the indication of an obtuse prominence at the apex. As the succeeding leaves appear the second year a small lobe develops at the apex. Even the first leaves may when vigorous or when older become slightly wavy margined. Variations in the length of the petiole of the leaf, and its replacement have already been referred to.

The most interesting part of the Bloodroot seedling is the hypocotyl. When just come out of the seed this organ does not seem to differ from that of ordinary seedlings where it is present. It contains a four rayed radial wood bundle as in the typical root. The bundle is surrounded by an endodermis and within this the pericycle. Secondary development begins in a few days and after the first leaf has reached the light and expanded, the xylem portion of the bundle increases rapidly in area. Secondary tissue as pith appears in the centre. The hypocotyl at first swells out greatly due to rapid growth and multiplication of the cells in the cortex; after a week or two this outer growth slackens and the subsequent thickening is mostly due to the enlargement of the pith. The mestome strands in the older rhizome which is developed from the hypocotyl, do not increase in great numbers, but soon are scattered in the circle of the cambium. The interfascicular cambium is well developed.

Lubbock* in his work on seedlings refers to somewhat similar enlargements of the hypocotyl of seedlings. The first case is that of our common radish, *Raphanus sativus*, Linn., the thickened edible "root" of which is developed from the hypocotyl.† The root stock of *Cyclamen persicum*, Mill, is likewise developed from the hypocotyl.‡ In *Testudinaria elephantopes* Burch.‖ a similar embryonic thickening is recorded. This plant seedling seems to be entirely rootless for a time. The upright rootstock of Cyclamen, the thickened primary "root" of the radish, and the rhizome of Bloodroot are then developed

* Lubbock, J. A Contribution to Our Knowledge of Seedlings, 2 vols. 1892.

† Ibidem. Vol. I, p. 178.

‡ Ibidem. Vol. II, p. 184.

‖ Ibidem. Vol. II, p. 576.

from the embryonic organ, the hypocotyl. In the case of the Bloodroot the hypocotyl soon twists around horizontally and becomes an elongated creeping structure, the rhizome. As it grows new leaves and scales from year to year, buds are left behind and these account for the branching of the older rhizomes. The twisting around of the hypocotyl may be noticeable within the first week of growth.

The primary root, or the continuation of the underground hypocotyl does not seem to increase in thickness at all. As the hypocotyl assumes its horizontal position, the primary root and its branches become soon aborted and wither away. This twisting and also the gradual disappearance of the first root is strikingly evident in the series of plants in the accompanying illustrations. Secondary adventitious roots soon develop from the lower side of the horizontal hypocotyl now become the new rhizome. All the roots of Bloodroot after the second year are undoubtedly adventitious. Lubbock reports such adventitious roots on the seedlings of *Begonia villosa,* Lindl.§ at an early stage of growth.

Examination of plants older than two years has not been systematically made, so that there is no direct evidence as to the manner in which the older rhizomes branch. It is not even known to us whether the buds may not be adventitious, though this is not likely. In any case, the lengthening out of the rhizomes is a very slow process under ordinary circumstances and extended and continued systematic study of older plants is necessary. The size and number of the lobes of the leaf seem to have some connection with the age of the plants and this fact too has not been investigated.

Conclusions:

1. The cotyledons and hypocotyl of our form of Bloodroot, *Sanguinaria mesochora,* Greene, are hypogeal and chlorophylless.
2. The rhizome or rootstock of the plant is developed from the horizontally twisting hypocotyl, which increases in thickness, at first by enlargement in the cortical area, and later in the center or pith of the single radial bundle.
3. The primary root soon dies, at least before the second year, and all the roots of older plants are adventitious.

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§ Ibidem. Vol. II, p. 2.

New Plants from North Dakota.

J. LUNELL.

The native species representing the multiform Spurge family in North Dakota are, according to my experience, surprisingly few. I never found them on the virgin, undisturbed prairie, but any kind of injury to the ground enables them to germinate. Their minute description is as follows:

Chamaesyce aequata sp. nov.

Planta annua, obscure viridis, ex superiore radice 2-4 ramos crassos et tot graciles, sicut flabellum irradiantes, emittens; rami ipsi pluries furcati et profuse crescentes, humi prostrati, saepe 3 dm. diametro. Caulis teres, vivide et obscure ruber. Herba tota glabra est. Folia distincte petiolata, opposita, 5-17 mm. longa, spatulata vel oblonga vel obovata, ad basim angustata, obliqua, saepe falcata, crenulate-serrulata de superiore parte marginis magis curvatae usque per totam marginem minus curvatam, vel non raro per totam circumferentiam haud indentata. Apex obtusus, rotundatus (numquam truncatus vel retusus). Folia saepe zonam rubram latam in medio habent et marginibus vivide colorata sunt. Involucrum triangulatis lobis et subulatis. Semina fusca, quadrangulata, angulis eminentibus, inter angulos conspicue rugosa, et inter rugas depressa.

Annual, dark green, from a point immediately above the upper end of the root sending out 2-4 thick branches and as many slender branches, radiating not unlike a fan, the branches themselves branching out dichotomously and growing profusely, prostrate on the ground, often reaching 3 dm. in diameter. The stems are terete and bright red; glabrous as is the whole plant. Leaves distinctly petioled, opposite, 5-17 mm. long, spatulate or oblong or obovate, narrowed at the base, the outline more curved on one side of the median line than on the other, the less curved line often approaching the straight line or the inward bent (then making the whole outline falcate), crenulate serrulate from the upper third of the more curved line along the whole of the less curved line, the indentation quite often failing (the margin seemingly being obliterated by age), thus leaving the whole margin entire or nearly so. The apex is obtuse, rounded (never truncate or retuse). The leaves often present a broad, red belt along part of the median nerve and a bright coloration along their margins. The lobes of the involucre triangular and subulate. The

dark sage-colored seeds quadrangular with prominent angles, the slightly ovate outline approaching the cylindrical form, or with an unequal contour, presenting the straight line on one side and the curve of the ovate line on the opposite, the space between the angles conspicuously rugose and depressed between the rugae.

The plant grows where the ground is level, and develops its fullest beauty where no intruding plants share with it the space needed for its entire expansion.

A species that may be apt to be confounded with this is *C. rugulosa* (Engelm.) Rydb., with its thickly matted growth and leaves toothed along the whole of the less curved side, but its seeds are turgid and very finely rugulose, with deep and irregular pits, and the apex of the leaf is retuse (vide Pttonia II, plate 1). *C. serpyllifolia* (Pers.) Small, differs in having oval, retuse leaves, crenulate at the apex, is procumbent (Persoon. Synopsis Platarum, Vol. II, p. 14]1807[, and has an angled, in the type almost winged stem (vide, Pittonia, l. c.). *C. neo-mexicana* (Greene) is erect, with branches acutely angled, with elongated, sharply pointed seeds, the two ventral facets being concave, and the lobes of the involucre entire or 2-3-cleft. *C. consanguinea* (Engelm.) is rather erect, the apices of the leaves are obtuse and sharply serrate, the lobes of the involucres are lacerate, the seeds are quite dark, rather ovate and blunt on the angles, and the stems and leaves have a more or less red coloration. *C. glyptosperma* (Engelm.) Small, is erect spreading, has linear-oblong, usually falcate and toward the apex slightly serrulate leaves, and quadrangular seeds with 5 or 6 sharp transverse wrinkles and no pitting between these.

The natural disposition of the plant is to spread prostrate upon the ground, but even the least obstacle in its way prevents it from coming there. In this respect it is unlike most other creeping plants, who work their way easily around or between the obstructions. Certain natural conditions force the plant to take the ascending course, and it then appears as the following variety:

C. aequata var. **claudicans** nov. var.

Ascending, freely branching; the branches are drooping, more or less. It grows on level ground, roadsides, etc. There is something in the way, as for example one or two stems of grass or other plants, a dead leaf, etc., preventing it from spreading over the ground and on account of its aversion to "crookedness," it is forced to grow in a direction diametrically contrary to its native impulse. But it drops its branches longingly toward the ground which they can never reach. This

variety, having to accept conditions that are opposed to its natural tendencies, becomes more or less checked in its growth thereby, but it is no such restraint to the type which attains a size widely surpassing it.

Chamaesyce erecta sp. nov.

Planta annua, viridescens, glabra, erecta, 1-2 dm. alta, furcata, ramos bifurcatione productos etiam aetate breves et plerumque simplices praebens nec raro duos prope aequales ramos e basi emittens. Caules teretes, virides, vel rubescentes. Folia breviter petiolata, ½-1½ cm. longa, spatulata vel obovata, basi obliqua, serrulata de dimidia parte superiore marginis brevioris usque per totam marginem longiorem viridescentia, vel rubescentia, numquam medio rubro-maculata, apice obtusa et rotunda. Semina angulis eminentibus ornata, vel tuberculata vel rugosa, inter tubercula vel rugas haud vel leviter foveolata.

Annual, light green, glabrous, erect, 1-2 dm. high, dichotomously branched, but leaving the branches (even at the end of the season) short and usually simple, or sometimes forking out into two equal main branches from the base. Stems terete, green or light red. Leaves short-petioled, ½-1½ cm. long, spatulate or obovate, oblique at the base, serrulate from the upper half of the shorter side down the whole length of the longer side, light green or light red, never with any red blotch in the median line, apex obtuse, round. Seeds with prominent angles, rugose or tuberculate, with shallow or no impressions between the rugae or tubercles.

It differs from the other erect species of this group, *C. neomexicana* (Greene) and *C. consanguinea* (Engelm.), chiefly by the extended indentation of its leaves, and by other characters mentioned above.

The type locality for these spurges is Leeds, N. Dak., where the first named species is common and the other is sparingly found during the months of July and August. The extension of their territories is unknown to me.

Ranunculus eremogenes Greene var. **Longissimus** var. nov.

Rooting from the nodes with long slender fibres. Stem 8 dm. long; to this length has to be added that lowest unmeasured part of the plant which I was unable to secure from the bottom of the creek where it was growing. The lower leaves very long-petioled (1.5-4.5 dm.). Collected on June 27, 1907, in running water at Leeds, North Dakota.

Senecio Purshianus Nutt. var. **viridescens** var. nov.

This plant differs from the main form in not being constantly white-tomentose, as it becomes gradually greener the more it approaches the time of maturity; in addition, its texture is very soft and herbaceous. It grows in places thoroughly exposed to the sun, preferably high hills. Its flowering time is June, and it is common in central North Dakota.

Some time ago I submitted this variety to Dr. E. L. Greene, asking him to describe it for publication. He expressed his opinion of it in a letter to me, but did not promise to publish it. In introducing it the golden rule of giving every one his due justifies and commands my acknowledgement of this indebtedness to Dr. Greene.

Corisperm simplicissimum nov. sp.

Planta annua, gracilis, erecta, simplex usque ad inflorescentiam, parte media e tribus valde foliosa, foliis partis inferioris e tribus probabiliter pallescentibus et caducis. Planta tota, imprimis pars ejusdem superior, pubescens etiam aetate, circa 3 dm. alta altiorve, in inflorescentiam multiplicem terminans, unius spicae longae terminalis, et 1-7 spicarum breviter pedunculatarum, vel aliquando subsessilium, angustartum, divergentium, in supremis foliis axilarium. Folia anguste linearia, cuspidata, 2-4 cm. longa, 1 mm. lata vel minus, pubescentia. Bracteae 2-12 mm. longae, 1-1.2 mm. latae, subulatae, margine scariosae, tam latae vel latiores quam utriculum. terminalis 3-7 cm. longa et iis minus angustata. Bracteae per terminalis 3-7 cm. longa et iis minus angustatae. Bracteae per totam inflorescentiam plus minusve densae. Achenia alata singulis vel ambobus lateribus, 2.5 mm. longa, 1 mm. lata ovalia et bractea subtendente cooperta.

Plant annual, slender, erect, simple up to the inflorescence, quite leafy on the middle third, the leaves of the lower third probably fading and dropping earlier in the season. The whole plant, especially in its upper part is pubescent, even in age, and about 3 dm. tall, or taller. Leaves narrowly linear, cuspidate, 2-4 cm. long, 1 mm. wide or less, pubescent. Bracts 2-12 mm. long, 1-1.2 mm. broad, awlshaped, scarious-margined, all as wide or wider than the utricle. The inflorescence is composed of one long spike on top, and 1-7 short-peduncled or sometimes subsessile narrow, divergent spikes in the axils of the upper leaves.

The lateral spikes are 1-2.5 cm. long, narrow, and the terminal spike is 3-7 cm. long, not quite as narrow. All the bracts in the spikes are more or less loosely crowded. Fruits wing-

margined on one or both sides, 2.5 cm. long, 1 mm. broad, ovoid, all covered by the subtending bract.

The predominant feature of this species is its peculiar aspect, the stem being simple throughout to the top with its short peduncled spikes in the upper axils. Its nearest relative, *C. nitidum* Kit., is bushy-branched throughout; its leaves are narrowly linear and seldom more than 2 cm. long; its bracts are not imbricated and are narrower than the utricle, which is 2 mm. long and 1 mm. wide and winged, and the plant is almost glabrous.

C. hyssopifolium L. is profusely branched throughout, its leaves up to 6 cm. long and 4 mm. wide: its bracts are imbricated and its utricle is 3.5-5 mm. long, winged.

I have made out the characters of both of these species from European specimens in my herbarium. All the three aforesaid species are floriferous at the top only. Four other North American species belonging to the west, differ in being floriferous nearly to the base, and divaricately branched below. Two of these, moreover, have a wingless utricle.

The type specimen of *C. simplicissimum* is registered as No. 112 in my private herbarium. The plant was collected by me Aug. 26, 1890, on the shore of a lake several miles southeast of Barton, Pierce Co., North Dakota, as yet the only locality from which it is known to me.

Leeds, North Dakota.

The Laboratory Aquarium.*

J. A. NIEUWLAND.

The term aquarium in its broadest sense may be said to mean any vessel or receptacle for the development of aquatic life. It is most commonly applied to a tank or vessel for keeping the larger aquatic animals. In the latter sense very little reference will be made to the word in this discussion. Most of us may be best acquainted with the term as used for something to keep or domesticate fish and fishlike animals mostly for pleasure. I shall discuss the subject leaving out entirely this interpretation of the word, and confine myself entirely to the laboratory plant aquarium. However, much may have been

*Paper read at the meeting of the Indiana Science and Mathematics Teachers, Richmond, Ind., March 5, 1910.

written on animal aquaria, the literature on growth of plants, — and I refer especially to the microscopic forms,— is indeed meagre. The subject is, however, not without the greatest interest, especially to teachers in high schools and colleges, where competent laboratory work is done. No one will question the desirability of having live plant material for study, and pickled forms are used only when no other is available. Many of the lower forms of plants and animals can only be studied at their best in the motile live stage, and the reason students often carry away from the laboratory false notions is because the living moving plant is seldom seen or at least not as often as might be if the teacher realized that with a little extra effort, a marvelous interest could be stimulated in the student, with living plants. Much trouble is anticipated by the teacher in getting live specimens of the lower plants, especially the algae, but a little acquaintance with the habits of these too little known forms, will reveal the fact that much of the anticipated trouble is imaginary.

The plant aquarium is, however, absolutely necessary for a consistent study of microscopic plants in laboratory classes. Most of the laboratory work in cryptogamic botany has by custom or accident, or I know not what other reason, been relegated to the winter or early spring months, and part of this time at least no live specimens can be brought from the field, supposing even that the teacher knew just where to get any given plants. We must then naturally fall back upon attempts at domesticating these lower forms or, to a large extent, fall back upon the less satisfactory methods of using pickled material or prepared slides. The best teachers will never for habit study give students prepared slides when living material is at hand, and in this way, endless explanations about stains and other artificial things are avoided.

We may say after a number of years study of the best ways of developing plants in the laboratory for class use, that we must at the very outset take for granted that the plant aquarium is as different from the average animal aquarium as their respective inhabitants are, and the treatment accorded each in order to succeed is entirely different, in fact, in most cases quite opposite. Even the vessels that give best results in growing or domesticating aquatic animals are entirely different from the vessels that will give good results in growing plants. These vessels are invariably of glass, because allowing better penetration of light, which is, of course, more necessary to plants than animals. It is pretty well conceded that large square vessels made of separate plates of glass, cemented together by various mineral cements, are bst adapted for ani-

mals. At least such large several pieced vessels seldom explode, or crack.

Microscopic plants are susceptible to subtle influences of environment which are mostly unknown to us. The plant aquarium must be entirely of glass or other absolutely insoluble material like porcelain. Metals in contact with water in plant jars are fatal. Carbon dioxide present in small traces in water where living things are growing will dissolve minute quantities of otherwise insoluble metallic compounds, such as rust or oxides, and carbonates resulting in the formation of more or less soluble bicarbonates. Soluble metallic salts are ionized in water and therefore toxic. These substances may be almost imperceptible to analysis or at least but traces, but there is enough to prove fatal to plants. Even tap water may contain too much iron in solution. Many microscopic plants seem to be killed off by iron almost as easily as by lead, and this would seem all the more strange as iron is a necessary constituent of chlorophyl. Other plants appear to resist the action of iron only because they are able in some way to precipitate it from solution as a sulphide, and thus render it harmless. This can be easily shown in jars when Protococcoideae abound. The walls of the vessel become coated with a brownish layer which can easily be washed off with dilute acids when hydrogen sulphide comes off. The conjugatae, especially Spirogyra, do not seem to be able to precipitate iron nor resist its toxic action. Not being able to get rid of it they promptly die.

It is not true that larger aquaria are best for growing algae, though such are unquestionably most desirable for animal development. My experience of some years past is that the valuable plants for class demonstration are grown in glass vessels of medium size of less than a gallon capacity and not exceeding two gallons. The very best plants, and often in great variety, have been growing in vessels holding little more than an ordinary tumbler carefully covered to prevent evaporation and access of dust. I have at present in the laboratory the best variety of desmids I have ever seen in a laboratory culture. The vessel is shallow and wide and when full, holds not quite a pint of water. It has stood covered for months and contains innumerable specimens of Staurastrum, as also several species of Closterium and Cosmarium. These are constantly dividing.

Another jar has stood in the laboratory for about six months, having been filled with some Spirogyra and other conjugatae from the field, together with some sticks and debris

in very small quantity. The Spirogyra has completely disappeared and the jar now contains, besides the prettiest Chroococcus I have seen, Oedogonium forming zoospores, Conferva with zoospores escaped, a very rare stage which I have never seen in the field. The plant is so common as to be a nuisance in spring, both in pools and in the laboratory. The small vessel has been systematically robbed of part of its contents for pickling and supplying other laboratories, and it still continues to develop new material of the old forms, and shows indications of producing new plants. This vessel is a round heavy glass box of the Bausch and Lomb make, and not more than four inches high and in diameter inside.

Some plants prefer shallow wide vessels, other grow best in deep vessels. I find that most prefer shallow ones, and when grown in deep ones develop generally only at the surface of the water. Fish globes are satisfactory but liable to crack and explode. Baloc beakers are cheapest and best because wide: those of five litres or less most convenient. They never explode, but are thin walled and must be handled carefully, especially when containing a soil or sand layer in the bottom. I have several twenty gallon aquaria but cannot remember a single really valuable plant or valuable stage of a common plant produced in them. They are excellent for preserving Utricularia, Salvinia, Lemna and larger aquatic plants. Utricularia is a valuable asset in the plant aquarium for trapping entomostraca, cyclops and other small animals in a plant culture. A plant immersed for a few days in the jar where these are present with valuable plants will soon reduce the animal devastators by catching them in their insectivorous bladders. They are then removed, as algae do not thrive with these higher plants present. Larger aquaria are especially good for growing small animals, such as entomostraca, snails, Fragania, Tubifex, planarians, Fairy-shrimps and hosts of others which live together harmoniously, or succeed one another. I have found that a larva stage of a dragon fly makes the best policeman for plant aquarium. When turned loose for a day or two destructive animals rapidly disappear. The larva lives long. I have had one do service for over a year. If left continuously in the plant jar its clumsy movements interfere with plant growth. There is no animal so destructive as the water snail. No plant culture will succeed when these are present and there seems no remedy, but to start without them. They must be picked out by hand one by one. Most of the animals mentioned, though valuable to the teacher of zoology for demonstration, are an intolerable nuisance in the aquarium. Animals should always be kept in separate jars

and they always get by themselves sooner or later, after devouring all traces of plants.

As to the method of treatment that appears to be beneficial in developing microscopic plants in the laboratory, we may say in general, that it consists essentially in a process of domestication. This is as true of plants as of animals. All processes of domestication give results in proportion to the degree that they succeed in giving the captives conditions as near as possible to those enjoyed in the field where they develop as in their natural home, or as near as possible to the conditions in which the captives can be coaxed to accommodate themselves easily.

Quite a variety of methods of treatment of plants in the aquarium have been discussed already,* and I refrain from repeating such explanations, and will refer only to the most important in passing, trusting that such of my hearers as are especially interested will be able to consult the article in question. The most important fact, in developing plant and also animal life in the laboratory jars when desired is to have nearby in the field, places where desirable specimens are wont to develop. By going to such places one can in a few days or weeks obtain excellent laboratory material out of season by a method already referred to. Even in winter when little plant life exists or is dormant, or in the drought of summer when the pools are dried up, one can by taking a handful of soil or mud or debris from such places obtain laboratory cultures by simply putting this soil in the jar in small quantity and covering with water, and awaiting results. One must be cautioned to use a small amount of such mud, less than one-twentieth of the whole contents, or bacterial decay will destroy everything. It does not always happen that the specimens especially sought appear, but usually some others as valuable develop. Nor does the same material come from the mud taken from the same places and put in separate jars. Size of containers and other unknown influences cause variations. This method I have compared to the "forcing" of the higher plants before their regular time, and it is elsewhere explained with detail. It is also explained why direct transfer of mature and fully developed forms to the laboratory is not so satisfactory as the "forcing" method. Every teacher of botany or zoology realizes, I believe, the importance of having available localities for collecting material, but it has not been so fully understood how necessary this is for the success of the laboratory aquarium.

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*The American Midland Naturalist, Oct., 1909, Vol. I, pp. 82-87.

What are the conditions of the best collecting grounds in the field? I have often observed the tendency of collectors of water plants to betake themselves to large bodies of water, rivers and lakes, and ponds, and have very often seen them return hopelessly discouraged. If they persist they lose much valuable time, and finally give up collecting, thinking that their locality is barren. The best results are obtained from pools of water that are dried up part of the year. Wherever water constantly collects so as to be wholly submerged the year around, frogs, large water insects, aquatic and even fish will gain an access and destroy plant life. The plants can hardly develop their spores before being devoured by these enemies. Moreover, the period of rest during the dry season seems necessary to preserve the vitality of some algae. It is a matter of observation that few microscopic plants grow in large bodies of water, except Cladophora Hydrodictyon, Draparnaldia, Chaetophora, Chara. To prove how fish relish spirogyra, a small amount may be put in a globe with goldfish and it will rapidly be eaten.

Many collectors attempting laboratory cultures in aquaria have somehow got passessed of the idea that the water must be changed to prevent decay. I have thoroughly discussed this, but too much emphasis can not be laid on the matter. *Paradoxical as it seems, few plants can stand such treatment, and most will either die or be much retarded in development. A moment's reflection will tell us the reason. I have said that microscopic plants find great difficulty in adjusting themselves to surroundings, because being so small, they are benefitted or injured by insignificantly small factors, and it is just because they have great difficulty in accommodating themselves to new environment that we must refrain from putting them in a new condition by daily changes of water. In the second place, when plants are present in healthy condition, the very oxygen they give off is a check on bacteria, and when healthy, they can keep the water purer in this way than we can by changing it.* Water is not impure because green plants grow in it. Moreover, green plants are put in fish aquaria in order to keep the water oxygenated.

When it is necessary to bring fully developed plants into the laboratory aquarium from the field, they should be allowed to remain in the water taken from their habitat, unless there is a chance of a new generation developing. Some algae may stand the changes of water once, many promptly rebel and die. We may then take the chances of getting a new culture from the spores produced as the plants disappear. In any case, by keeping all cultures several months before throwing out a jar

which seems to be unproductive for a time, we often find some remarkable growths later. Absolute decay by bacteria indicated by changes of color and offensive odors as also complete choking up of the contents by oscillatoria are the signs that the contents of a jar are beyond the stage of future usefulness.

The reason why the "forcing" method is the best is the following. Mud collected in the field in dry or adverse conditions, even in winter, contains spores which seem in the resting stage eagerly awaiting a chance to develop. They will come out even under comparatively unfavorable conditions or will then make a special effort to accommodate themselves to even a possible existence. They will even develop in the laboratory in winter, because the change from the field to warm room is not unlike the advent of spring to them, especially if the light is strong. Resting stages contained in the mud can more easily resist adverse conditions. Plants and animals go into the resting stage or form hypnospores for this very reason of resisting adverse conditions.

Plant aquaria should be covered with a plate glass, both to keep out dust and also to prevent rapid evaporation. Water will evaporate slowly despite all efforts. This must be replaced little by little. Adding too large an amount at one time may prove fatal. The addition is also necessary to keep up the available food salt of the plants. Addition of water must never exceed one-fifth of the contents of the aquarium. The salts used by plants and present in all natural water may be also replaced by adding Sach's tablets, as these contain the proper proportion of mineral salts necessary to their development.

Good light, in fact very strong, and direct sunlight is necessary to many algae. The average material develops well, however, in diffuse sunlight. I have tried for some years to keep up cultures of Euglena, Pandorina Haematococcus or Sphaerella in the laboratory but without success, and have finally found that my failures were due to want of sunlight. These plants, I have already shown, grow best in midsummer in places where organic matter is decomposing in direct blistering sunlight, e. g. the wallows of pigs, pools around watering places, and near barns. I have once seen a basin of water containing manure at the bottom and covered one-half an inch deep with the Englena. This pool about 30x60 feet square was covered by a layer of the purest culture of Euglena. I have even found in the motile stage. It would be a pretty problem of mathematics to attempt to calculate the number of organisms present when we reflect that the animal, as you

may wish to call it, is only 30-40 microns long. (Less than 1-500 of an inch.

Our professor of zoology can obtain and keep vegetative euglenae at will, by putting some crumbs of bread in a jar of stagnant water. Bacteria and mould will come out only in small quantities because it decays in direct sunlight. He obtained Haematococcus and even the rare stages of conjugation and daughter cell formation, by taking debris from a place where such were found in the field and adding rain water. His laboratory is, however, on the south side of the building where he has direct sunlight most of the day.

Microscopic animals, on the other hand, seem to develop better on diffuse sunlight and in large vessels. I have obtained some specimens of Zoothamnia, fragania, fairy-shrimps, and spongelike animals that were quite rare, or were not reported from this part of the country, and they develop in great numbers. Hydras, both the small green species (*H. viridis*) and the larger chlorophylless one (*H. fusca*) come in great abundance in late spring and early summer, both in large and medium sized aquaria and are usually found together, the latter disappearing first as its food gives out, the former chlorophyl bearinf remaining for months.

When water is too alkaline, or contains too much lime in solution, a few plants of chara should be introduced into the aquarium. The plant is called Stonewort, because of large quantities of calcium carbonate present in it. Plants introduced in summer grow readily and fruit well the oospores remain in good condition till germinating in spring.

Tapwater is used for the aquarium unless it contains too much iron. The water must be allowed to run some time before filling a jar, as water standing in pipes, especially iron or lead pipes, is dangerous. Water contains iron when it leaves a brown spot, where it drips constantly.

An inch of sand in the bottom of vessel is sometimes beneficial, when animals are present it is objectionable as they find a refuge, then bury themselves and can with difficulty be removed. Soil is sometimes good but often serves as a hiding place for worms like Tubifex, and this might be remembered by those who want animal rather than plant forms. When soil is taken from the natural habitat of the plant it is an advantage, but when taken in larger proportion than one-tenth of the contents of the jar, will usually grow more animals than plants.

In transfering algae from the field to the laboratory only a very small amount of material should be put in each jar, or decay will result rapidly. Though algae appear sometimes in

aquaria in dense masses leaving little room in a jar, it must be remembered that they do so only after they have made their environment favorable by counteracting all adverse influences. Large quantities of algae can never be kept in the laboratory unless they appear of their own accord. Conjugatae are especially difficult. Ulothrix is out of the question as are all forms that thrive in running water.

The stage of congugation of Spirogyra is seldom developed in the laboratory, possibly because of insufficient sunlight. Nearly all conjugatae except *Spirogyra nitida* conjugate in Spring. (April, May.) Desmids conjugate but never abundantly in captivity. Diatoms and zoospores of Vaucheria develop best from material brought into the laboratory in winter. The former become extremely active when brought from the cold outside to the warmth of the laboratory. The latter seem to be affected by the change as if spring came. They produce numerous zoospores in a few days. Nearly all algae appear periodically though the periods are not fixed, and therefore the contents of a jar not containing active bacteria nor infested with oscillatoria should not be thrown out too soon. Algae are at times slow in coming out, but great varieties follow one another once the conditions are favorable. A recent example in my laboratory will illustrate this point. Some Spirogyra was put into a jar last summer. It contained some Mougeotia and Zygnema also, besides a small amount of grass blades and debris. The vessel was put aside in strong light and almost forgotten till one day a month ago, a deposit of plankton was found in the bottom. Examination revealed a small amount of the aforesaid algae but large quantities of zoospores of conferva and some oedgonium in similar stage. Chroococcus was abundant later. This jar of not over one and one-half pint capacity contained the best stages of these algae I have seen. The jar was robbed systematically and is still developing. Protococcus forms are just beginning to appear.

Laboratory cultures are usually better than field cultures, not only because they are, generally speaking purer, but because they afford continuous study of successive stages. In the field even, one is often tempted to do superficial cursory examinations of larger areas rather than intensive continual observation of one small pool. Needless to say, the latter method brings best results. We shall be astonished what a great variety of specimens we may obtain from one small pool, if we watch it carefully and long enough. I obtained the largest amount of my best and rarest material from some drain holes along a railroad only a quarter of a mile of its length. The laboratory jar is always at hand and ready for examination,

hence most convenient for intensive work. Even when we have a good field for collecting, the aquarium is an indispensible adjunct to class work, and ever for research. Ecology and habits of plants and animals cannot be studied as well in the field as in the transparent jar. I will cite but a simple example. The omnivorous worm, Tubifex, is an inhabitant of pools periodically dry, and in sluggish streams it is often so abundant that the bottoms are colored red by the large number. There has been considerable comment whether this worm, Tubifex, (so called because it builds a case or tube around itself), has its anterior in the mud or out of it. These animals are constantly swaying back and forth in rhythmical motion, to cause water currents. They are often several inches long, about the thickness of a thread, and the approach of any enemy causing a disturbance in water near, is sufficient to make them retreat instantly into the ground and no trace of them is seen until quite is restored. Some will invariably dig down at the edge of the aquarium and their anatomy from one end to the other may thus be studied through the glass with a magnifier, and without in the least disturbing them. Sound waves do not seem to effect them, though sound travels in water and when the vessel is struck a sharp resounding rap, they are not affected as some other small aquatic animals are. Some zoologists have maintained that these worms are imbedded "head first" in the mud, others claim their heads or anterior portion is extruded, and I am told that the matter has not been settled. Now it does matter very much whether a worm wants to stand on its head or otherwise, but it is very easy to settle the problem viewed in the aquarium, though in the field none seem to have been able to decide. A few moments observation will show to the veriest tyro that the food which these worms are continuously eating is seen passing upwards through their transparent bodies and finally cast out above, causing in part, the formation of the tube around them, from which they get their name. I have asked many students, some mere beginners, and all could solve the difficulty in a few seconds of observation.

This is only one instance to show that if we wish to become better acquainted with the lower forms of life we must bring them near to us and study their ecology. The difficulties of field study are such that little has been done heretofore with algae ecology. The aquarium for microscopic plants may in the future solve some of these problems, besides being a help and convenience for class work.

SUMMARY OF REQUISITES FOR SUCCESS WITH THE LABORATORY AQUARIUM.

1. Use the right kind of jar, i. e., smaller one-pieced glass vessels for plants and larger ones for animals; shallow and wide aquaria for plants, deeper ones for animals.
2. Good light. Diffuse daylight is generally best. Direct and even strong sunlight for algae grown in summer.
3. Avoid access of dust and minimize evaporation.
4. Avoid presence of mineral salts and alkalinity of water.
5. Never change water nor add more than one-fifth of contents of the jar.
6. Advantages of the "forcing" method should be realized. Therefore, contents of an aquarium should be kept several months unless bacteria or oscillatoria or animals invade it. Give the spore stages a chance to appear.
7. Remove all animals as much as possible from plant aquaria.
8. Study the ecology of specimens in the field, and give the specimens in the laboratory jars as much as possible their native outdoor habitat, e. g., regarding light intensity, depth of water, kind of water, etc.
9. Find a good collecting ground preferably pools, dry part of the year, in order to replenish the laboratory jars, and do intensive rather than extensive field work.
10. Interest, perserverance and patience especially at the start.

Our Birds in October and November.

BROTHER ALPHONSUS, C. S. C.

The reason why the writer failed to see three species of birds on one day only in October can be accounted for in two of the instances. On the 16th he did not visit a certain piece of lowland overgrown with brush, where he always found the Goldfinch, and on that day he did not see the bird elsewhere. The Song Sparrow was not seen on the 29th, the first time it was not found since its arrival on March 6th. Up to the date of its departure, on Nov. 8th, the bird was seen irregularly. I cannot account for not seeing the Snowbird, unless it be

that this species usually moves in flocks, seldom leaving individuals behind.

The fact that the Brown Creeper was seen only twice in October and four times in November leads me to think that this species is not abundant here. If this is not the case, like the scarcity of the Chickadee, I am unable to account for the Creeper's rarity in this locality.

During October the White-throated Sparrow was abundant as the Snowbird, but not so widely distributed as the latter species. The former shows a preference for swampy land. The Golden-crowned Kinglet was both abundant and widely distributed. The writer thinks the Bobwhite is now a rare bird in St. Joseph County. It was found by him only on one day, in October, since March 1, 1909.

In November the appearance only on one day of the Cardinal, Northern Shrike, Hairy Woodpecker, Belted Kingfisher, Mourning Dove and Towhee was due to the fact that these were migrating birds.

OCTOBER.

Bird seen every day: Blue Jay.

Birds not seen on any day: Purple Finch, Ruby-crowned Kinglet.

Birds seen every day except on dates after their names:

Snowbird, 22.
Myrtle Warbler, 10, 11, 26, 27, 28, 29, 30, 31.
Goldfinch, 16.
Chipping Sparrow, 11, 12, 14, 15, 17, 20, 25, 27, 29, 30, 31.
Golden-crowned Kinglet, 28, 29, 30, 31.
Crow, 13, 21, 27, 30.
Song Sparrow, 29.
White-throated Sparrow, 5, 25, 27, 28, 29, 31.

Birds seen on dates after their names:

Brown Creeper, 6, 16.
Yellow Palm Warbler, 14.
Chickadee, 24, 25, 29.
Downy Woodpecker, 11, 12, 17, 18, 19, 22, 23, 25, 26.
Killdeer, 3, 5, 7, 8, 9, 16, 28 to 31.
Yellow-billed Cuckoo, 6.
Flicker, 1, 2, 5, 9, 14, 15, 23.
Field Sparrow, 1, 8.
White-breasted Nuthatch, 2, 4 to 8, 12, 15 to 20, 22, 29.
Chimney Swift, 2, 3.
Bluebird, 1, 2, 4, 6, 14, 15, 16, 18, 19, 20.
Cowbird, 4, 6, 15, 16.
Brown Thrasher, 4, 5, 6, 9, 10, 11.
House Wren, 6, 7, 15.
Towhee, 9, 15, 17 to 27.
Nighthawk, 13.
Bobwhite, 24.
White-crowned Sparrow, 1 to 4, 6, 16, 18.
Hermit Thrush, 2, 6, 7, 12 to 16, 18, 20, 21.

Mourning Dove, 2, 3, 5, 7, 8, 24.
Kingfisher, 4, 10, 11, 12.
Screech Owl, 24, 30, 31.
Meadowlark, 1, 2, 4to 7, 9, 16, 17, 23, 26, 27.
Robin, 1, 2, 3, 5 to 9, 11, 13, 14, 16, 17, 18, 24, 26.
Vesper Sparrow, 1.
Yellow-billed Sapsucker, 4 to 9.
Kirtland Warbler, 4.
Purple Grackle, 6, 9.
Phoebe, 7, 9, 13.
Yellow-throated Vireo, 11.
Fox Sparrow, 20, 22.
Hell Diver, 12, 15, 24, 29.

Number of species seen each day:

October	1, 16.	October	16, 16.
"	2, 18.	"	17, 13.
"	3, 14.	"	18, 16.
"	4, 18.	"	19, 13.
"	5, 16.	"	20, 13.
"	6, 22.	"	21, 10.
"	7, 18.	"	22, 12.
"	8, 15.	"	23, 13.
"	9, 17.	"	24, 16.
"	10, 10.	"	25, 9.
"	11, 12.	"	26, 10.
"	12, 13.	"	27, 7.
"	13, 11.	"	28, 7.
"	14, 13.	"	29, 7.
"	15, 15.	"	30, 6.
		"	31, 5.

Total number of species seen, 41.

NOVEMBER.

Birds seen every day except on dates after their names:

Snowbird, 6, 7, 14, 16, 22, 27.
Crow, 1, 6, 7, 9, 10, 11, 13, 16, 19, 20, 22.
Blue Jay, 14.
White-breasted Nuthatch, 1, 5, 6, 7, 11, 13, 14, 16, 17, 22.

Birds seen on the dates after their names:

Flicker 2, 17.
Song Sparrow, 2, 3, 4, 7.
Robin, 3, 26.
Downy Woodpecker, 4, 7, 12, 15, 16, 19, 20, 21, 23, 25 to 28, 30.
Brown Creeper, 12, 13, 27, 29.
Cardinal, 19.
Screech Owl, 25.
Mourning Dove, 29.
Golden-crowned Kiglet, 2, 12, 13,16,19.
Goldfinch, 3, 7, 8, 12, 15.
Belted Kingfisher, 8.
Tree Sparrow, 9, 12, 13, 14, 15,
Towhee, 15.
Hairy Woodpecker, 23.
Northern Shrike, 29.
Bobwhite, 30.

Number of species seen each day:

November 1, 2.	November 16, 3.
" 2, 7	" 17, 4.
" 3, 7.	" 18, 4.
" 4, 6.	" 19, 6.
" 5, 3.	" 20, 4.
" 6, 1.	" 21, 5.
" 7, 4.	" 22, 1.
" 8, 6.	" 23, 6.
" 9, 4.	" 24, 4.
" 10, 3.	" 25, 6.
" 11, 2.	" 26, 5.
" 12, 8.	" 27, 5.
" 13, 4.	" 28, 5.
" 14, 2.	" 29, 6.
" 15, 8.	" 30, 6.

Total number of species seen, 20.

Total number of species seen in October and November, 46.

Notes on Priority of Plant Names.

J. A. NIEUWLAND.

In looking through the second edition of the Herbarium Blackwellianum, published by Trew,* I found that this author in his own notes to this great work had restored a number of older generic plant names before other authors to whom they have been usually accredited.

These restorations are always made under the special caption, "NOMEN GENERICUM," so that their significance can not be doubted.

Elizabeth Blackwell's names seem to be left quite as they were in the original pre-Linnaean edition, and I shall not make any reference to these. The famous handcolored plates of the first Herbarium Blackwellianum are also reproduced. The following cases of priority are worthy of mention:

* Herbarium Blackwellianum, by Elizabeth Blackwell, Second edition in Latin and German, Century I-V, re-edited by Christopher Jacob Trew, Century VI, or Appendix by Christian Gotlieb Ludwig, Norimbergae, 1754-1773. [The volumes have no page numbers in the text, only the plates being numbered.]

(1) *Bursa*, Trew, 1757†, instead of
Bursa, Ludwig, 1760, or
Bursa, Wiggers, 1780, or
Capsella, Medicus, 1792.

The genus is not published in a way that would lead one to suppose the name is a generico-specific binary. The genus is referred to Heucher,‖ ‖ 1711, who also uses the single word, *Bursa*, and who was the first to publish it under that caption.

(2) *Persicaria*, Trew., 1754, instead of
Persicaria, Hill, 1756.

The first species mentioned in a binary Trivial name *Persicaria maculata* or *Persicaria maculosa*, hitherto called *Polygonum Persicaria*, and the type of the genus *Persicaria*. It is worthy of note that Trew also reduces to this genus what the old herbalists called Hydropiper, or as we know it, *Persicaria Hydropiper*. He does not, however, designate the species under a binary name as he does in the case of *Persicaria maculata*.

(3) *Coronopus*, Trew, 1754‖, instead of
Coronopus, Zinn, 1757.

(4) *Tithymalus*, Trew, 1754§, (in part) instead of
Tithymalus, Duhamel, 1755.

(5) *Abies*, Trew, 1754,** instead of
Abies, Duhamel, 1755.

(6) *Sassafras*, Trew, 1757,†† instead of
Sassafras, Nees and Eberm, 1831.

Through a reprint of 1866 there has come to my notice the fact that in 1754 there had been published a work or rather a list of plants* from the Botanical Garden of Amiens, France. The author is stated by M. Richer† to have been Dom. Robbe, founder of the botanical garden of that city. Robbe's name does not appear on the title page, and the list was "published

† l. c. Cent. I, Tab. 5.

‖ ‖ Heucher, J. H., Index Plantarum Horti Medici Academiae Vitembergensis, 1711, p. 14. "*Bursa*. Vulgo Bursa pastoris offic."

‡ l.,c. Cent.II, Tab. 118.

‖ l. c. Cent. II, Tab. 120.

§ l. c. Cent. II, Tab. 123, and 163.

**l. c. Cent. II, Tab. 198.

††l. c. Cent. III, Tab. 267.

* (Dom. Robbe.) Catalogue des Plantes Usuelles avec une explication des principaux Termes de Botanique, poor servir d'intrduction aux Démonstrations commencees dans le jardin de Botanique le 27 Juin 1754, Sous les auspices De Mgr. le Duc De Chaulnes, etc.

A Amiens, Chez la Veuve Godart, Imprimeur du Roi, de Mgr. le Duc de Chaulnes et de l' Academie, MDCCLIV.

† M. Richer, Discours prononcé a l' ouverture du cours communal de Botanique de la Ville d'Amens le 16 Mai, 1866, p. 74.

under the auspices of Mgr. le Duc. de Chaulnes." A number of generic names appear in this list, earlier than in any other work of my knowledge, and the identity of them is always made clear by references to the works of such authors as Tournefort, Caspar Bauhin, Morison, etc. If under these circumstances credit is due to Robbe for priority of publication, I leave to others to decide. The following names seem to be affected. I shall also add the names of authors, to whom the plants have hitherto been attributed since 1753.

(1) *Tithymalus.* (p. 102.) or
Tithymalus, Trew, 1754,
Tithymalus, Duhamel, 1755.*
Five species are mentioned.

(2) *Malus.* (p. 103.)
Malus, Duhamel, 1755.

(3) *Filipendula.* (p. 110.)
Filipendula, Hill, 1756.

(4) *Abies.* (p. 111.)
Abies, Trew, 1754.
Abies, Duhamel, 1755.

(5) *Ulmaria.* (p. 112.)
Ulmaria, Hill, 1756.

(6) *Cerasus.* (p. 115 and p. 138.)
Cerasus, Duhamel, 1755.

(7) *Lauro-Cerasus.* (p. 115.)
Laurocerasus, Duhamel, 1755.

(8) *Argentina.* (p. 119.)
Argentina, Hill, 1756.

(9) *Dracunculus.* (p. 120.)
Dracunculus, Morandi, 1761.

Dracunculus polyphyllus is given as a binary Trivial name to the species.

(10) *Polygonatum.* (p. 125.)
Polygonatum, Hill, 1756.

(11) *Bistorta.* (p. 125.)
Bistorta, Hill, 1756.

(12) *Persicaria.* (p. 129) also
Persicaria, Trew, 1754.
Persicaria, Hill, 1756.

Four species are mentioned; what we call *Persicaria maculosa* or *Polygonum Persicaria,* Linn., *Persicaria Nicotianae folio, Persicaria mitis floribus candidis,* C. B. P., p. 192, and *Persicaria urens seu Hydropiper,* C. B. P., p. 107.

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* For references of synonymes see Am. Mid. Nat. pp. 16 et seq. 49 and 164.

(13) *Chamaenerion.* (p. 129.)
Chamaenerion, Ludwig-Böhmer, 1760.
(14) *Melilotus.* (p. 130.)
Melilotus, Hill, 1756.
(15) *Fagopyrum.* (p. 135.)
Fagopyrum, Hill, 1756.
(16) *Alnus.* (p. 136.)
Alnus, Duhamel, 1755.
(17) *Lycopersicon.* (p. 137.)
Lycopersicum, P. Miller, 1759.
(18) *Valerianella.* (p. 138.)
Valerianella, Hill, 1756.
(19) *Grossularia.* (p. 138.)
Grossularia, Duhamel, 1755.
Two species of the last are mentioned.
(20) *Albutilon.* (p. 133.)
Abutilon, Hill, 1756.
(21) (H) *Elianthemum.* (p. 131.)
Helianthemum, Shaw, 1757.
(22) *Pulsatilla.* (p. 105.)
Pulsatilla, Hill, 1756.

Dryopteris a Synonym.

J. A. NIEUWLAND.

Adanson's name *Dryopteris** has been recognized as an older one for the genus formerly called *Aspidium,* Swartz, 1800.† It has been found, however, that since 1753 Schmidel‡ gave a name earlier than either of the above to this group of ferns. Though the authors of *Dryopteris* and *Aspidium* seem to choose as the type of the genus the Linnaean species *Polypodium Filix mas* Linn., Schmidel chose the plant of Linnaeus called *Acrostichum Thelypteris,* Linn., but both of these are not considered separated into different genera at present.

Schmidel in restoring the name *Thelypteris* refers to Ruppius.* Kuntze believes that the *Thelypteris* of Ruppius is

* Adanson, M., Familles des Plantes, 1763. Vol. 2., p. 20.
† Swartz, O., Schrad. Jour. Bot. 2:4, 1800.
‡ Schmidel, Casimir Chr., Icones Plantarum et Analyses Partium, curante et edente Joannes Chr. Keller, Pictore Norimbergensi Typis Christiani de Lavnoy, 1762. Manip. I, Secto 1, p. 45.
* Ruppius, Haller, Fl. Jen. 1745.

the same as Adanson's *Thelypteris* or the *Thelypteris* of the ancients, which plant is none other than *Pteris aquilina,* Linn., now type of the genus *Pteridium.* On the basis of absolute priority this name is the true one for what we now call *Pteridium aquilinum* (Linn.) Kuhn. Such is the confusion caused by not accepting the older pre-Linnaean names for plants. This is but a single instance of many where botanists who go back no further than 1753 for their names, must if consistently following their principles to their logical conclusion, accept names given as the result of misunderstanding of the authors who first quoted them. Whatever may have been the *Thelypteris* of Ruppius, or of the ancients, there can be no doubt that the *Thelypteris* of Schmidel is *Dryopteris Thelypteris* (Linn.) A. Gray, and therefore, the oldest name since 1753 for any segregate form Linnaean genera containing *Acrostichum Thelypteris,* Linn,

Schmidel devotes four folio pages to the description, and history of the plant. A full page plate [Plate XII.], colored, of the plant is given. One-third of his plate XIII. contains illustrations with explanations of the arrangement of sori and sporangia. The description together with the exact plates showing spore dehiscence and other even microscopic characters is so minute and convincing, that any one knowing the plant, *Dryopteris Thelypteris* (Linn.) A. Gray, would recognize it at a glance. I have reproduced the plates of Schmidel herewith.

The function of annulus of the sporangium in dispersal of spores is perfectly described and illustrated, together with other microscopic details. Considering the age of the work with its drawings and description the publication is certainly remarkable.

Although, therefore, *Thelypteris* is the pre-Linnaean name for *Pteridium* and the valid one on the basis of absolute historic priority, the name as applied by Schmidel to *Acrostichum Thelypteris,* Linn., makes it the oldest for the genus *Dryopteris,* since 1753. Following is the synonymy of genera and species. As I have no sympathy for confounding names, nor feel any respect for codes, congresses, or systems of nomenclature that by contradictory rules bring about such confusion, I do not want to be responsible for even the new combinations, and only indicate a few for the sake of making clear the changes that may be followed by such as consider 1753 as the beginning of nomenclature in modern botany.

Thelypteris (Ruppius?*) Schmidel, 1762, not *Thelypteris*, Adanson, 1763 or other pre-Linnaean authors.
(*Dryopteris*, Adanson, 1763.)‡
(*Aspidium*, Swartz, 1800.)
(*Lastraea*, Presl. 1851.)†

(1) *Thelypteris palustris* (Ruppius*) Schott, 1834.
Dryopteris Thelypteris (Linn.) A. Gray, 1846.
(*Aspidium Thelypteris* (Linn) Sw., 1800.)
(*Thelypteris Thelypteris!*)
(*Acristichum Thelypteris*, Linn., 1753.)
(*Lastraea Thelypteris* (Linn.) Presl.)

(2) *Thelypteris simulata* (Davenp.).
(*Aspidium simulatum*, Davenp., 1894.)
Dryopteris simulata, Davenp., 1894.

(3) *Thelypteris noveboracensis* (Linn.).
Dryopteris noveboracensis (Linn.) A. Gray, 1848.
(*Aspidium noveboracense* (Linn.) Sw., 1800.)

(4) *Thelypteris fragrans* (Linn.)
Drypteris fragrans (Linn.) Schott, 1834.
(*Aspidium fragrans* (Linn.) Sw., 1800.)

(5) *Thelypteris marginalis* (Linn.).
Dryopteris marginalis (Linn.) A. Gray, 1848.
(*Aspidium marginale* (Linn.) Sw., 1806.)

(6) *Thelypteris Filix mas* (Linn.).
Dryopteris Felix mas (Linn.) Schott, 1834.
(*Aspidium Filix mas* (Linn.) Sw., 1800.)
(*Polypodium Filix mas*, Linn., 1753.)

(7) *Thelypteris Goldiana* (Hook.).
Dryopteris Goldiana (Hook.) A. Gray, 1848.
(*Aspidium Goldianum*, Hook., 1822.)

(8) *Thelypteris Bootii* (Tuckerm.).
Dryopteris Bootii (Tuckerm.) Underw., 1893.
(*Aspidium Bootii* Tuckerm, 1843.)

(9) *Thelypteris cristata* (Linn.).
Dryopteris cristata (Linn.) A. Gray, 1848.
(*Aspidium cristatum* (Linn.) Sw., 1800.)

(10) *Thelypteris spinulosa* (Retz.).
Dryopteris spinulosa (Retz.) Kuntze, 1891.
(*Aspidium spinulosum* (Retz.) Sw., 1800.)

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‡ Adanson, M. Familles des Plantes, 1763, p. 20.
† In C. Babington's Manual of British Botany, 1851. Ed. III.
* Ruppius, H. B. Fl. Jen. Ed. II, p. 277 (1726)
Thelypteris palustris non ramosa.

The Passenger Pigeon.

F. J. WENNINGER

The habit of association in large herds common to some animals served to protect them under primeval conditions. But when man came upon the earth, these very conditions operated to the disadvantage of the animals in question. Among the best known examples to be cited in illustration of this fact are the Bison, the Beaver, and Wapiti and Deer, the history of whose extermination is too well known to require repetition.

Just now, we are confronted with the fact that another of our once common animals has become so scarce that it is questionable of existence. This time it is a bird,— the Passenger Pigeon (*Ectopistes Migratorius*).

This bird was once exceedingly common, so common that reports on the number of this pigeon contained in some of the treatises on Ornithology of the last century, are little short of fabulous. In 1813, the celebrated Audubon observed a flock of passenger pigeons numbering at least 1,115,000,000 individuals. Studer in his "Birds of North America" published seventy-five years after Audubon's work, refers to the size of the flocks of these birds which he observed. He says, "the flocks were very large but none even one-fourth the size of those seen by Audubon." In "Bird Neighbors," by Neltje Blanchan, 1898, only a decade after Studer's calculations were made, the passenger pigeon had already become so scarce that the writer remarks, "the bird is now too rare to be included among our bird neighbors." Again, in 1901, an observer writing for the "Library of Natural History," gives a detailed description of the bird and its habits. This author also concludes with a reference to the growing scarcity of the bird. "The vast numbers of this pigeon," he writes, "have greatly diminished during recent years and now the bird is on the verge of extinction. It is certain that unless laws are made for its protection, its extermination is only a matter of time." Reed's, "Bird Guide," 1909, contains no mention whatever of the bird.

All the vast region ranging along the eastern part of North America as far west as the Mississippi Valley and north to the Hudson Bay, once so thickly populated with this bird that as many as ninety and even a hundred and ten nests have been counted on each tree for a distance of three miles,— all this territory is now so entirely devoid of representatives of this species that there is grave reason for doubting the existence of the bird.

There is now a movement on foot to prevent, if possible, the complete extinction of the passenger pigeon. At a recent meeting of the American Ornithological Union the matter was discussed by Prof. Hodge of Clark University. In consequence of this, a prize has been offered for "the first information of a nesting pair of wild passenger pigeons *undisturbed.*" It is the hope of Col. Kuser, the donor of this prize of $300, that its offer will stimulate workers in the field of Natural Science and will promote efforts towards the protection and safety of this bird. Shortly after Col. Kuser's offer was announced, John Lewis Childs added a prize of $700 to the original award. Thus the first undisturbed nesting pair of passenger pigeons found anywhere on the North American continent will be worth one thousand dollars to the finder.

Occasionally the warning is sounded that some bird or beast is becoming extinct. But efforts to preserve these animals are usually extremely feeble in comparison to the cry raised over species that are already extinct. No amount of criticism will restore the Bison to our Western plains. The thing to do is to stop the wanton destruction going on at present. Just now it is the jays and especially the eagles that are diminishing in numbers. If instead of lamenting the ravages of animal life in the past, well directed efforts were made to prevent their repetition in the future, something worth while would be accomplished.

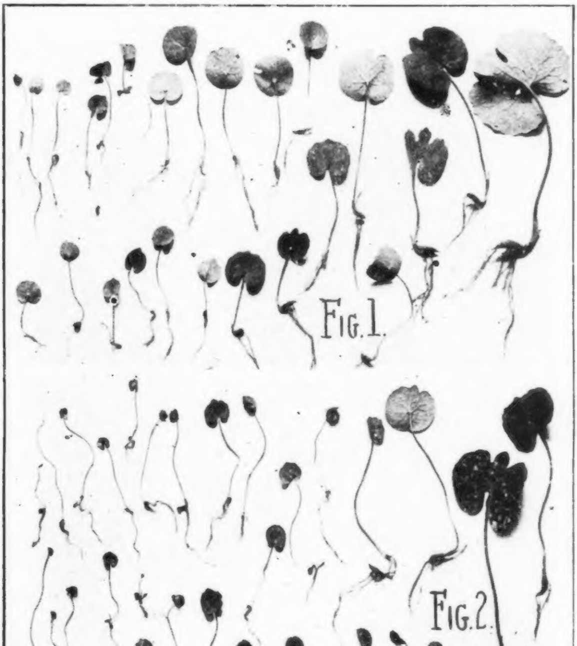

PLATE XV NIEUWLAND ON BLOODROOT.
Figs. 1 and 2 about ¼ natural size.
Fig. 3 One half natural size.

Photo by J. Huerkamp